DTMF Code Lock

using clever discrete logic

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Whether simple or ‘uncrackable’, whether constructed from discrete logic or using a microcontroller — code locks have become something of a tradition in *Elektor Electronics*. This one, however, is different!

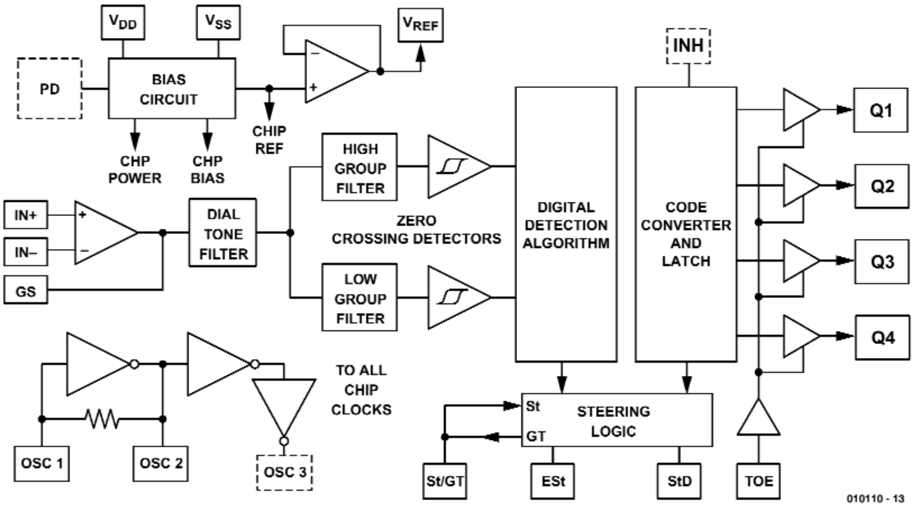

Figure 1. Internal circuit diagram of the CMD type CM8870 DTMF decoder.

This special code lock has no keyboard, but instead responds to DTMF tones, as produced by any modern mobile phone or, of course, a pocket DTMF generator. Since no-one who is anyone leaves their house these days without their mobile phone (although they might forget their front door key), almost anyone will be able to use this device.

The lock presents to the outside only a microphone capsule and four LEDs, which show the status of the unit. Their function will not be obvious to the uninitiated. The electronics consists mainly of standard components and contains no programmable devices at all.

From tones to logic levels

Our starting-point in the circuit shown in **Figure 2** is the CM8870 DTMF decoder produced by California Micro Devices (IC2), which takes the DTMF signal from the microphone after it has been processed by the op-amp at its input. The gain of the op-amp can be set from 200 to 700 using trimmer potentiometer R3. If a tone from the microphone is recognised as DTMF, the digit pressed is presented at the outputs Q1 to Q4 as a binary value. The StD signal on pin 15 goes high to indicate valid data.

Each valid entry results in the yellow LED flashing off briefly. The StD signal also serves as a clock for the type 4017 decimal counter IC8. When the first digit is entered the counter moves on one step, and the Enable1 signal goes high. The output of the decoder always represents the last DTMF digit received. If the value set on one input to the comparators IC3 to IC6 by the BCD-encoded switches matches the DTMF digit, the ‘equals’ output (pin 3) of that comparator goes high. A gate (IC7) at the output of each comparator determines whether the digits have been entered in the correct sequence, the enable signals being taken from the corresponding outputs of the 4017 counter.

If the gate is enabled, a correct digit entry will trigger the connected monostable. The period of the monostable is about 4 s, during which time code entry must be completed. When all four monostables are set, monostable IC12A is triggered via IC11A, which operates the door-opener relay for 5 s. The green LED indicates when the lock is open.

As soon as the Enable4 signal is activated, monostable IC12B is triggered, which provides a delayed reset pulse to the 4017 counter. This means that after a code (correct or not) is entered, there is a delay before the lock is ready to be operated again. After this blocked period a new code can be entered. LED3 and LED4 show whether the lock is blocked (red) or ready (yellow).

The circuit operates from a single +5 V supply, which is provided by voltage regulator IC1. When power is applied it is possible for the 4017 counter not to be in its reset state. In this case the reset button can be pressed, which resets the counter to zero.

Now for a few words on the construction and installation of the code lock. Despite the relatively large number of components, it is perfectly practical to build the circuit using prototyping board: the circuit is not critical. One exception: the wires to the microphone capsule, if it is not to be mounted on the circuit board, should be shielded and kept short. The LEDs, if mounted off the board, can be connected with ordinary signal wire. All the ICs (except the voltage regulator) should be fitted in sockets. Domestic door-opener relays usually operate from 24 V AC; 230 V versions are, however, also available. The relay used must be suitable for the voltage to be switched. Also, all the usual precautions must be observed when dealing with mains voltages.

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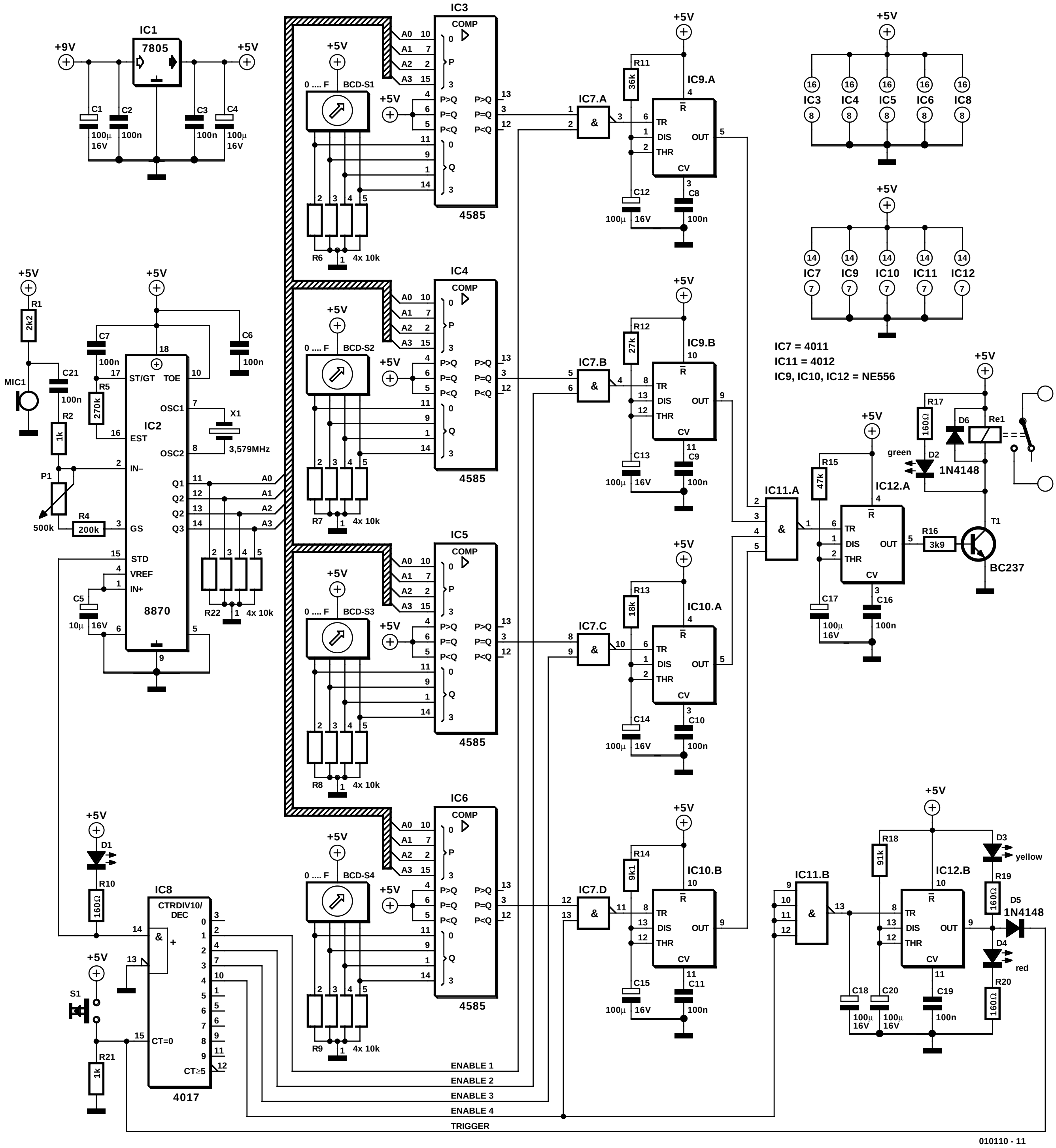

Figure 2. Circuit diagram of the DTMF code lock.